

## BELLCOMM, INC.

955 L'ENFANT PLAZA NORTH, S.W.

WASHINGTON, D. C. 20024

SUBJECT: Trip Report - 4th Quarterly  
AMPT Review, 1/15/69, Los  
Angeles, Calif., and 3rd  
Program Review RREP 1/28/69,  
West Palm Beach, Fla. - Case 105-3

DATE: February 11, 1969

FROM: C. Bendersky

ABSTRACT

Highlights of the latest program reviews of the on-going Air Force advanced development programs are described as presented by the industry contractors. The programs are the:

1. Advanced Maneuvering Propulsion Technology Program (AMPT) of Rocketdyne, and
2. The Reusable Rocket Engine Program (RREP) of Pratt and Whitney.

The RREP is the prime candidate propulsion program for use in  $LO_2/LH_2$  recoverable boosters now under study at NASA.

(NASA-CR-103918) TRIP REPORT - FOURTH  
QUARTERLY AMPT REVIEW, 15 JANUARY 1969, LOS  
ANGELES, CALIFORNIA, AND 3RD PROGRAM REVIEW  
RREP 28 JANUARY 1969, WEST PALM BEACH,  
FLORIDA (Bellcomm, Inc.) 6 p

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MEMORANDUM FOR FILE

The writer attended the latest program reviews of the two on-going Air Force advanced development programs (ADP) for cryogenic engines. The Advanced Maneuvering Propulsion System (AMPT) (AF Project 3) is under contract to the Rocketdyne Division of NAR and is to result in a demonstration firing of a complete propulsion module. The module is sized for use on a Titan III D launch vehicle. The Reusable Rocket Engineering Program (RREP) (AF Project 2) is under contract to Pratt and Whitney and is to result in a series of firings of a demonstrator engine of a size suitable for consideration in reusable integrated reusable spacecraft/launch vehicles now under study throughout the industry. Both programs are classified. The following describes the unclassified progress.

1.0 AMPT

(The propellants used in this contract are classified.)

The fourth quarterly progress report of the AMPT program was held at Rocketdyne, Canoga Park, Calif., on 1/15/69. An agenda of the meeting is appended. Prior to the AMPT report, Rocketdyne presented their latest (concluding) data on their NASA LO<sub>2</sub>/LH<sub>2</sub> 250,000 lbs thrust Aerospike test program. The NASA Advanced Engine Aerospike (AEA) test data have demonstrated the following:

1. satisfactory combustor development is possible using a segment for testing rather than the complete (360°) aerospike;
2. 94-96% c\* (combustion efficiency) was obtained at mixture ratios above 5;
3. full thrust stable runs were obtained in 5 second duration tests; and

4. estimates of engine performance were 450 seconds  $I_{sp}$  (max) at an expansion ratio ( $\epsilon$ ) of 75:1. This level is low compared to a high pressure (RREP type) engine of the same exit diameter.

Phase I of the two phase AMPT program has been extended from 24 to 31 months supposedly to "deepen the combustion testing." Phase I completion is now scheduled for mid 1970. Rocketdyne is being supported under subcontract by two vehicle design contractors, Lockheed Missiles and Space Co., (LMSC) and General Dynamics Convair Division (GD). Both companies presented their progress. Both are on schedule with each having some basic differences of design philosophy. However, stage performance is comparable. Lockheed showed some pictures of reusable spacecraft designed for use with AMPT engines as based on contract design studies with the Air Force Flight Dynamics Laboratory. If used in such an airplane, the AMPS engine potentially must start from a negative "g" condition. This requirement is not part of the present AMPT operating limits.

In summary the AMPT program is progressing down the extended path without any anticipated problems. The contractors briefings (Ref. 1,2, and 3) are available from this writer.

## 2.0 RREP

The third program review on the Air Force Project 2 "Reusable Rocket Engine Program" (RREP) was held at Pratt and Whitney at West Palm Beach, Fla. on 1/28/69. The RREP has resulted in the designation of the XLR 129 P-1 engine system which is defined as follows: "the XLR 129 P-1 is a high pressure 250,000 pound thrust reusable oxygen/hydrogen rocket engine with a two position exhaust nozzle," (unclassified).

The RREP is a 54 month program (now in the 15th month) designed to culminate in a series of 30 full scale engine system tests of a "demonstrator" (flight type, not flight weight) configuration. Specifications of performance, duty cycles, etc. are classified. The program is on schedule with most of the design effort completed and initiation started of hardware fabrication and procurement. Sufficient testing of bearings and seals were reported to provide confidence for design selection.

While at Pratt and Whitney, through the offices of Col. T. McCreery (AF Rocket Propulsion Laboratory), a discussion of development philosophy, schedules, budget and planning estimates was held with key Pratt and Whitney personnel. Sufficient data

were provided to document the cost and development philosophy for use in Bellcomm in-house studies. These will be described in a classified memo to be published in the near future. The following unclassified comments are cogent. The driving force in philosophy is aircraft engine past experience. This philosophy states that propulsion oriented development costs decrease significantly if the engine development program is continued well beyond PFRT (pre-flight rating test) because of the resulting improved engine reliability. 700 full scale full duration tests are proposed to PFRT and 2,000 to engine qualification based on reliability criteria. The large amount of hardware necessary to support this size test program is a major item of the cost in a RREP flight engine development program. The impact of the present RREP program is small as it contains only 30 full scale tests. Another significant cost factor because of the large number of tests required is that of  $\text{LO}_2/\text{LH}_2$  propellants--from 35 to 50% of the total R&D costs.

A copy of the RREP presentation (Ref. 4) is available from this writer.

*C. Bendersky*  
C. Bendersky

1013-CB-nma

Attachments  
References  
Agenda

BELLCOMM. INC.

REFERENCES

1. BCI 69-2, "AMPT Program Fourth Quarterly Review, January 15, 1969," (U) Rocketdyne, Division of NAR.
2. R NO GDC-BNZ68-040, "AMPS Fourth Quarterly Progress Report," (U), General Dynamics Convair Division, January 15, 1969.
3. LMSC-682491, "AMPT 4th Quarterly Program Review," January, 1969," (U), Lockheed Missiles and Space Company.
4. PWA GP 69-9, "Third Program Review of the Air Force Reusable Rocket Engine Program," (U), Pratt and Whitney Aircraft, Division of UA.

AGENDA

AMPT PROGRAM FOURTH QUARTERLY REVIEW

Rocketdyne Div. of NAR

15 January 1969

Introduction	W. J. Brennan
AEA 250K Test Program	W. R. Studhalter H. C. Wieseneck

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AMPT Program Overall Summary	R. R. Morin
Task I - Engine System Analysis and Design	A. T. Zachary
Task II - Critical Engine Component Demonstration Testing	D. H. Huang
5-Inch Thrust Chamber Segment	
30-Degree Thrust Chamber Segment	
Main Thrust Chamber	
Oxidizer Pump Bearings and Seals	
Task III - Propellant Feed System - Introduction	H. G. Diem
Convair - Task III	C. F. Peters
Overall Task III Status	
Subsystems Analysis and Design	
Design Variation Studies	
Lockheed - Task III	
Overall Task III Status	J. H. Guill
Subsystem Analysis and Design	R. T. Parmley
Design Variation Studies	J. H. Guill